

LOCAL GOVERNMENT BOARD.

REPORT  
ON  
BACK-TO-BACK HOUSES,  
BY  
DR. L. W. DARRA MAIR,  
WITH AN  
INTRODUCTION  
BY THE  
MEDICAL OFFICER OF THE BOARD.

A report on Relative Mortality in Through and Back-to-Back Houses in certain Towns in the West Riding of Yorkshire.

Presented to both Houses of Parliament by Command of His Majesty.



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## INTRODUCTION BY THE MEDICAL OFFICER.

To the RIGHT HONOURABLE JOHN BURNS, M.P.,  
President of the Local Government Board.

SIR,

The investigation which Dr. Darra Mair was instructed to make into the effect on health of living in back-to-back houses forms the subject of the report now presented.

The necessity of securing trustworthy statistics on a sufficiently large scale, and of ensuring the accuracy of the complicated calculations based on them, has inevitably prolonged the investigation ; but some interim results have already been published in a table given in my annual report for 1908-9. This table, revised, is reproduced as Table XV. on page 48 of this report.

The problem has been studied, as in previous inquiries on the same subject, by instituting comparisons between death-rates in back-to-back and in through houses of similar class. In some or all of the following important particulars, however, Dr. Darra Mair's study differs from previous studies of the subject. Thus the comparison between back-to-back and through houses has not been limited to one town, but has extended to thirteen industrial towns in the West Riding of Yorkshire. In the next place, the comparison of the two types of houses has been limited to houses in good structural condition situated in healthy areas, in order that, so far as practicable, the issue might not be confused by influences other than that of through ventilation. Thirdly, in order to avoid accidental statistical error, the vital statistics have been taken for a period extending over ten years. Lastly, and most important of all, the death-rates in this report have been corrected for variations in the age and sex constitution of populations. Failure to make such corrections frequently minimises the value of comparative statistics. Furthermore, mortality from different causes of death as well as from all causes in the aggregate has been closely investigated.

The statistical results thus obtained confirm, on the whole, the results of previous less complete inquiries. They show that even relatively good types of back-to-back houses, when compared with through houses, have a death-rate from all causes taken together which is 15 to 20 per cent. in excess of the death-rate in through houses ; although this excess is not evident in back-to-back houses built in blocks of four, possessing some degree of cross ventilation, unlike those built in continuous rows.

It is noteworthy, however, that in back-to-back houses there is excessive mortality from certain important groups of diseases, whether these houses are built in blocks of four or in continuous rows. The groups of diseases thus showing excess are diseases of the chest, like bronchitis and pneumonia, and diseases especially associated with defective growth and development of the young child.

Dr. Darra Mair's statistics show that it is the excess of mortality from these groups of diseases which is mainly responsible for the total excessive mortality in back-to-back houses. This result represents a definite advance in our knowledge of the causes rendering back-to-back houses undesirable dwellings.

The statistics also show that the excessive mortality associated with back-to-back houses falls chiefly on childhood and old age.

So far as statistics, compiled with the utmost regard to accuracy and strict comparability, can settle a question of this kind, it is certain that back-to-back houses, even those of a good type in healthy surroundings, are decidedly less healthy than through houses of a similar type; and that their provision as dwellings for the working classes is undesirable. By the Housing, Town Planning, &c. Act, 1909 (see. 43), the future erection of dwellings of this kind is made illegal.

As will be seen from the table on page 29, back-to-back houses have lower rents than through houses providing the same accommodation, approximately in the proportion of 5s. 6d. to 4s. 6d. The difference in rental is recompensed in better health, and in the facilities for self-contained family life of a satisfactory character, which is ensured by having air-space at the rear of as well as in front of the house (see pages 8-10).

I am, Sir,

Your obedient Servant,

ARTHUR NEWSHOLME,

Medical Officer.

20th July, 1910.

# Dr. L. W. Darra Mair's Report to the Local Government Board on Relative Mortality in Through and Back-to-Back Houses in certain Towns in the West Riding of Yorkshire.

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## I.—INTRODUCTORY.

In 1906 the Town Council of Dewsbury requested the Local Government Board to approve, in a new series of byelaws for new streets and buildings, a provision permitting, with certain restrictions, the erection of dwellings "back to back." The principal restriction proposed was that such "back-to-back" dwellings, if built at all, must be built in blocks of four with a clear space, not less than 10 feet in width, intervening between each block.

Among the arguments relied upon in support of this application it was urged that in certain towns in the West Riding of Yorkshire and in the neighbourhood of Dewsbury, *e.g.*, Leeds, Huddersfield, &c., the erection of back-to-back houses was permitted under the provisions of local Acts and byelaws, and was actually taking place; and that the development and growth of Dewsbury had been, and was being, retarded by the fact that similar houses could not be erected in that town, but only the more expensive "through" houses provided with space behind as well as in front, and with means of through ventilation.

The Board, after consideration of the application, informed the Dewsbury Town Council that they would be prepared to sanction a byelaw permitting the erection of back-to-back houses in blocks of four, but only on condition that the amount of air space required to be provided between the blocks should be at least equal to the minimum required, under the Board's model byelaws, to be provided at the rear of "through" houses. The effect of this decision was that the space between the blocks of four would have to be at least 20 feet in width, instead of 10 feet as the Town Council of Dewsbury had proposed. The Town Council objected to this decision, on the ground that the amount of land required would be such that there would be little or no difference between the cost of building a through house and that of building a back-to-back house, and that, therefore, the Town Council's aim in securing powers to permit the erection of a cheaper form of house than the ordinary through house would be defeated. As the Town Council pressed their original proposal, the Board eventually determined that inquiry should be

made with a view to obtain further information as to back-to-back houses in the West Riding of Yorkshire, and more especially as to their influence on the health of their inhabitants.

This inquiry has been prosecuted by me, from time to time, since the end of 1908, so far as the exigencies of current work have allowed. It has involved repeated visits to towns in the West Riding and the collection and collation of a large amount of statistical material. The collection of this material has necessarily been a gradual and lengthy process, entailing a very great amount of care and labour, in the first instance, on the part of the officials of the districts concerned; and I desire, at the outset, to tender these gentlemen my sincere thanks for the painstaking services which they have so cordially rendered in this respect. The collation and compilation of the statistical material after it had been secured has been a still more lengthy proceeding, which has necessarily fallen to me alone.

## II.—PREVIOUS INVESTIGATIONS.

In 1887, Dr. Barry and Mr. Gordon Smith made a joint inquiry, on behalf of the Board, regarding back-to-back houses, and in their well-known report\* they discussed the various types of back-to-back houses then being erected in the West Riding, and supplied information on numerous points relating to them. The comparative density on area of back-to-back houses and of through houses; the comparative cost of these two classes of dwellings, including the cost of land, construction of houses, proportionate amount payable for road making, paving, sewerage, &c., in each case, as well as the total capital expended and rental obtained; the structural arrangements of back-to-back houses, with reference to stability, prevention of fire, means of ventilation, arrangements for the disposal of excrement and refuse, and the amount of accommodation afforded in dwellings of different classes; these and other cognate matters were fully described in the joint report, and illustrated by means of many plans and sections.

As to the effect of the two classes of house upon the health of the inhabitants, Dr. Barry and Mr. Gordon Smith found that reliable information in the West Riding was wanting, and they were obliged to refer, by way of indicating such effect upon health, to certain statistics relating to Salford, in Lancashire, which had been furnished by Dr. Tatham, who was then the medical officer of health of that town.

This statistical evidence referred to two out of the four registration sub-districts of Salford. The two areas in question were densely populated, having a total population of nearly 100,000 with a density of 121 persons per acre, and comprised a conglomeration of many varieties of houses and conditions. These

\* Memorandum by Dr. Barry, and Joint Provisional Report by Dr. Barry and Mr. P. Gordon Smith, on back-to-back houses.

two large areas were each sub-divided, for the purposes of the inquiry, and classified into three groups; one comprising through houses entirely, the second comprising through houses and a moderate proportion (18 and 23 per cent.) of back-to-back houses, and the third comprising through and back-to-back houses in about equal proportions; and it was found that during a period of five years the average annual rate of mortality from all causes and from certain specified causes had been lowest in the first group and highest in the third group, the mortality in the second occupying an intermediate position. The relative rates of mortality from all causes in these three groups can be represented, approximately, by the figures 100: 106: 111, respectively, in the case of one registration sub-district (Greengate), and by the figures 100: 111: 143 in the case of the other district (Regent Road), showing that the rate of mortality from all causes increased, in each, with the increase in the proportion of back-to-back to through houses. Other figures, relating to the same districts, showed a somewhat similar progressive excess of mortality when such diseases as phthisis, pulmonary diseases other than phthisis, the common infectious diseases, and diarrhoea were separately taken into account.

It was pointed out, however, by Dr. Barry and Mr. Gordon Smith, that "very great stress cannot be laid upon the figures referred to," since they related to one town only, and a number of factors other than the presence or absence of means of through ventilation probably needed to be taken into account, while no data were available as to the ages at death or as to the age and sex constitution of the populations amongst whom the deaths occurred.

It is, for instance, conceivable that the differences of mortality, whether from all causes or from the specified causes, may have been due largely or even wholly to differences in the sex and age constitution of the populations concerned. Moreover, the rates of mortality disclosed in the Salford figures indicate that numerous factors, apart from differences of housing, must have been in operation. In the two registration sub-districts, as a whole, the mean annual death-rate from all causes during the quinquennium dealt with, was as high as 27.9 per 1,000, while in many of their sub-divisions the death-rates were very much higher. Even in the sub-divisions comprising through houses entirely, the death-rates ranged as high as 32.6, 33.8, 35.0, 37.2, and, in one case, 40.7 per 1,000. So that although, as was claimed, the conditions under which those who lived in through houses and those who lived in back-to-back houses may have been "fairly uniform" and comparable in, at least, one of the registration sub-districts in question (Greengate), it can scarcely be doubted that in certain parts of these areas grave influences prejudicial to health must have been in operation, and that amongst these influences the effect of the precise nature of the dwelling may have been relatively insignificant.

In 1903, Dr. Herbert Jones published\* the results of an investigation carried out at Shipley. Here, two districts were

\* "Back-to-Back Houses." *Public Health*, Vol V., 1892-93.

brought under review which were claimed to be similar in essential respects, except that in the one the houses, 850 in number and containing 4,218 persons, were all through houses, and that in the other the houses, 874 in number and containing 4,155 persons, were exclusively back-to-back. The rents of these houses were stated to be similar; the occupiers were described as belonging to the same class and as being engaged in the same work; the soil, water supply, sanitary arrangements, and building materials were also similar; and it was ascertained that the proportion of pauperism was 42 per cent. among the through houses, and 47 per cent. among the back-to-back houses.

The vital statistics of these two districts, during a period of six years (1887-1892), showed an average annual death-rate from all causes of 15.6 per 1,000 in the through houses, and 21.1 per 1,000 in the back-to-back houses, or an excess of 35 per cent. in the latter. Even when the back-to-back houses abutting on the widest streets (25 yards) were alone compared with the through houses, the death-rate from all causes (18.1 per 1,000) was found to be 16 per cent. higher than that in the through houses. Similarly, when the rates of mortality from the infectious diseases, from phthisis, and from pulmonary diseases other than phthisis, were separately taken into account, an excess was found among the back-to-back houses ranging from 26 to 57 per cent.

There is evidence, in Dr. Jones's account, that in the district containing back-to-back houses, factors may have been in operation other than the character of the dwelling. Some of the streets, for instance, are described as being *culs-de-sac*—"indeed, we might say that not only the houses but the very streets are back to back." This objection did not apply, however, to the relatively less crowded back-to-back houses abutting on the wider streets.

I had an opportunity of visiting Shipley in the course of the present inquiry, and it appeared to me that the through houses are more favourably situated than the back-to-back houses, especially in respect of elevation, and that there is more evidence of squalor in the immediate surroundings of the back-to-back houses.

But the statistics of this inquiry, like those of Salford, are open to the criticism that differences in the age and sex constitutions of the populations concerned could not be taken into account, and thus it cannot be said with certainty that the differences found in the rates of mortality were really due to other than merely arithmetical considerations.

Dr. Niven, medical officer of health of Manchester, was the first to examine, in an investigation of this question, the influence of age distribution. His annual report for 1894 contains an account of the relative mortality during a period of four years (1891-1894) in back-to-back houses existing in certain selected districts, nine in number, in Manchester, and in the total houses of all kinds in these districts; and in this account the death-rates from all causes and from certain specified causes for each of seven age groups, as well as for all ages, are set forth.

The results of this investigation, while confirming generally those of previous inquiries that mortality is greater in back-to-back houses than in through houses, showed that this excess of mortality is largely limited to the early and the advanced ages of life. Indeed, in the largest of Dr. Niven's selected districts the mortality at the adolescent and early adult ages (15-45) was usually less in the back-to-back houses than in the districts of which they formed part.

Another notable result of Dr. Niven's investigation was, that it did not show "that marked preponderance of phthisis (in back-to-back houses) which we should expect from previous investigations." The mean excess of mortality from this disease in back-to-back houses amounted to 11 per cent., but in three of the selected districts the mortality from this disease was less in the back-to-back houses, while in two others it was practically identical in both classes of houses.

It needs to be pointed out, however, that in nearly all Dr. Niven's selected districts the average annual rates of mortality from all causes were high, ranging, with one exception, from 24.8 per 1,000 to 36.3 per 1,000. Probably, therefore, important influences, other than the nature of the dwelling, were in operation.

Dr. Evans, medical officer of health of Bradford, in a paper read to the Epidemiological Society in 1896, has also compared the vital statistics of back-to-back houses and through houses. He brought under review three groups of houses in Bradford, "as alike in age, in sanitary circumstances, and in the class of artisans who occupy them, as it is possible to obtain." One of these groups comprised through houses, another back-to-back houses in rows, and the third back-to-back houses in blocks of four. The death-rates from all causes, during three years, 1890-1892, of these groups of houses were 15.1, 17.7, and 18.3 per 1,000 respectively, or as 100: 117: 121. The mortality was thus 17 per cent. higher in the back-to-back houses in rows, and slightly higher still in the back-to-back houses in blocks of four than in the through houses. On the other hand, mortality from phthisis was greatest in the back-to-back houses in rows, and lowest in through houses, the death-rates being, for the three groups of houses, 1.39, 2.41, and 1.68 per 1,000 respectively, or as 100: 173: 121.

For further purposes of comparison, Dr. Evans divided the wards of the city of Bradford into two groups, one group containing more than 60 per cent., and the other less than 60 per cent. of back-to-back houses, and it was found that the death-rate from all causes was 20 per cent. higher in the former than in the latter group, while the death-rates from phthisis and diarrhoea were 13 per cent. and 131 per cent. higher respectively. The statistics of this investigation are open, however, to the same objection as those of previous investigations, namely, that correction for differences in age and sex distribution could not be made, and, in addition, the period covered by them was short.

In 1907, in a report to the Board upon the housing of the Whickham Urban District,\* a colliery district in the County of Durham, I had the opportunity of presenting some statistics relating to certain back-to-back houses. These statistics, which covered a period of 10 years, showed an excess of mortality from all causes amounting to 27 per cent. in the back-to-back houses, and an excess of infant mortality which amounted to 50 per cent.

In this case, however, although the period covered by the statistics was long, the populations concerned were small, the back-to-back houses were of an inferior type, and it proved to be impossible to make any correction for differences in the age and sex constitution of the populations of the back-to-back and through houses. In this case, too, as was shown by the medical officer of health of Whickham, phthisis mortality was in excess in the through houses during the period under review.

In Table XV., in the Appendix, is a summary of the statistics of the foregoing investigations.

### III.—CHIEF DIFFERENCES BETWEEN THROUGH AND BACK-TO-BACK HOUSES.

It may be well to refer briefly to the principal points of difference between through houses and back-to-back houses. The essential difference, of course, is that in a through house both the front and back walls belong exclusively to the dwelling, while in a back-to-back house, the back wall is merely a party wall belonging in common to another dwelling at the rear, so that two dwellings are in contiguity, back to back, with the result that the existence of windows opening to the external air at the back of such houses is rendered impossible. Consequently, the free ventilation or perflation which can be obtained in a through house by opening the windows both at the front and at the back of the house cannot be obtained in a back-to-back house; and, further, in a back-to-back house of more than one storey, the air of the rooms above the ground floor is much more apt to be drawn from the more or less vitiated air of the rooms below than in a similar through house, since in the latter a direct current of air from outside can be set up, independently, on each floor.

Opponents of back-to-back houses contend that this inherent difference, in regard to ventilation, is a matter of serious moment; that as a result the air in the rooms of a back-to-back house is almost invariably close and "stuffy"; and that such a condition cannot but be injurious to the health of the inmates. There is no doubt that at times the sensation of stuffiness in the rooms of back-to-back houses is very marked indeed.

On the other hand, it is contended that the importance of the essential difference between the two types of house has been much exaggerated. It is claimed that through ventilation is feasible in every room of a back-to-back house which contains a fireplace as

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\* Dr. L. W. Darra Mair's report to the Local Government Board, on the Sanitary Circumstances of the Whickham Urban District, with special reference to its Housing Accommodation generally, and to certain Back-to Back Houses at Marley Hill in particular (No. 262).

well as a window, and that this through ventilation may be materially increased by means of special ventilating shafts, such as are not uncommonly provided in back-to-back houses in Leeds. The objection to the latter means of ventilation, however, is that they often give rise to "draughts," and that they are frequently closed permanently by the occupants. At the best, moreover, they do not enable that thorough perflation of the atmosphere of rooms to be effected which is possible by opening the windows at the front and back of a through house.

The difficulty of obtaining satisfactory through ventilation in back-to-back houses may be overcome, more or less effectually, provided they are built in blocks of four instead of in continuous rows; for, when so built, each house has, in addition to the front wall, an independent side wall, in which windows may be provided. With such an arrangement, a very large amount of through ventilation or perflation becomes possible, especially if the relative position of windows, doors, and fireplaces is skilfully devised. A good type of back-to-back house in blocks of four exists in large numbers in Morley and other towns. In Huddersfield and elsewhere, however, there is an unsatisfactory modification of this type, in which only the ground floor rooms can be provided with windows in the side wall, the upper floors being built so as to be a continuous row. The object of this modification is to increase the bedroom accommodation, but it destroys, to a very large extent, the benefits aimed at by building back-to-back houses in blocks of four.

There are other indirect disadvantages in the amenities of back-to-back houses which are of importance. One of these, which appeared to me in the course of my inquiry to be felt by the occupants of these houses more acutely than any other, is that frequently back-to-back houses are devoid or almost devoid of sunshine. As there are windows only in the front walls of back-to-back houses in rows, it follows that, unless these rows face almost due east and due west, the houses on the northerly side of the row can have but little sunshine in the summer months and probably none at all in the winter months. Moreover, those houses which possess the advantage of sunshine are not free from objection, for in summer weather, since all the rooms alike are exposed to the sun, they are apt to become intolerably hot. In a through house, on the other hand, some portion of the house is in sunshine during part of every sunny day, while in hot weather one side is cooler than the other.

The difficulty as to closet accommodation in connection with back-to-back houses is well known. The absence of a back-yard made it necessary in the older back-to-back houses to place the closets or privies and ash-pits in groups, either on one side or at the end of a row, with the result that the closet and ash-pit accommodation belonging to a house may be very far removed from it and, at the same time, often inadequate, while the proximity of the groups of closets and ash-pits to some of the houses is extremely objectionable. This disadvantage has been overcome in the newer back-to-back houses, for in consequence of modern improvements in sanitary fittings, it is now possible to provide a water-closet inside the house, either in a bathroom, or in an apartment,

approached from the outside, in the basement. The latter is a common arrangement in modern back-to-back houses in Leeds, where also each house is provided with an ashbin out of doors.

The absence of a back-yard is a drawback in other ways. A very common complaint to me was that its absence leads to lack of privacy. For instance, in the older back-to-back houses, owing to the want of the back-yard, the only available place for drying the weekly laundry in the open air is the public street, on lines stretched across and used in common by several neighbours. In modern back-to-back houses, however, this disadvantage has also been overcome, for in these there is usually a garden between the house and the street. In Leeds the provision of such a garden or yard in front of back-to-back houses has been compulsory in recent years.

Those who favour back-to-back houses contend that, even assuming that they possess disadvantages, they are more than balanced, especially in the newer houses of this type, by their advantages. The most important advantage claimed is that the back-to-back house is so much cheaper than the through house that the working man living in it is not tempted or compelled to have a lodger as he might be in a through house, and can spend more on food and luxuries. Another advantage claimed is that the back-to-back house is warmer than the through house, and therefore entails a smaller expenditure on coals.

It may be questioned whether the alleged relative warmth of back-to-back houses is a real advantage, and whether it may not be due to the restricted means of ventilation already referred to. There is no doubt, however, that the rent of back-to-back houses is materially less than that of similar through houses, as will presently appear, but as much of this comparative cheapness of back-to-back houses seems to depend, not only on the fact that there are fewer external walls to build, but also on the fact that, on a given area of land, it is possible to erect a greater number of back-to-back houses than through houses, the advantage is, perhaps, of doubtful value. The congestion of houses on area is a very grave defect, perhaps the gravest defect of all in the old back-to-back houses, and even in recent years it has been found desirable in Leeds to increase the restrictions against the crowding of back-to-back houses by requiring a greater width of street and a greater number of intersecting streets to be provided for them than for through houses. Had such restrictions been general in years gone by, and had it also been necessary to build back-to-back houses in blocks of four with side ventilation to the exclusion of those in continuous rows, it is questionable whether the relative cheapness of the back-to-back house would have existed.

#### IV. -SCOPE AND METHODS OF THE PRESENT INQUIRY.

In the present inquiry, I was met with the same difficulty as had been met with by Dr. Barry and Mr. Gordon Smith. Although they expressed the opinion in their report that "little difficulty would be experienced by local medical officers of

health in ascertaining the relative incidence of pulmonary disease, phthisis, diarrhoea and infectious diseases generally in houses of the two classes," and "that further and more exact information under this head is desirable," I found that such exact information was not available, and that no systematic attempt had been made to obtain statistical evidence in the manner indicated.

It was evident, therefore, that if such statistical evidence was to be obtained, it was only by special effort, falling, in the first instance, on officers of the local authorities concerned, that it could be procured. The assistance of these authorities was accordingly invoked by the Board, and, as I have already indicated, the officers of all those who were approached in the matter readily undertook the necessary investigation.

In settling the details of this special investigation it was necessary to avoid, if possible, the shortcomings, already referred to, of previous statistical evidence. Thus the chief aims of the present inquiry came to be, first, to obtain comparative statistics relating to as large a population as possible living in a *number* of towns; second, to select areas for this purpose in which not only was it clear that the conditions affecting the inhabitants of both classes of houses were comparable, but also as to which it could be affirmed, with some certainty, that no exceptional influences prejudicial to health were in operation; and, third, to obtain data which could be corrected for differences in age and sex constitution. At the same time it appeared to be desirable to obtain statistics for a longer period than that covered by most of the previous investigations, and it was therefore decided to deal with a decennium, the period chosen being the years 1898-1907.

These conditions made it necessary to choose from among areas containing, either intermingled or adjacent to one another, comparable back-to-back and through houses, only those areas which could be regarded as healthy. Thus, only a good type of house, whether through or back-to-back, could be brought under review, and "slums," unhealthy, dilapidated, or congested areas were altogether excluded. At the same time it was necessary to select houses which were more than ten years old, and furthermore those only which had been in fairly constant occupation during the decennium dealt with.

As the inquiry progressed, the importance became more evident of obtaining comparative data, not only for back-to-back houses built in rows, and therefore devoid of any window ventilation other than from the front wall, but also for those so constructed, whether in blocks of four or otherwise, as to be provided with substantial means of ventilation from the side as well as from the front of the house. Consequently areas had to be sought containing the latter type of back-to-back house as well as through houses.

In order to obtain data as to the influence of age and sex distribution on the statistical evidence, it was clear that not only a mere numerical census of the populations of the selected areas would be required, but also details as to the age and sex of every inhabitant. Such information, though not sufficient in the absence of corresponding details at the beginning of the decennium, to enable

a statistically complete correction to be made for the influence of age and sex, was obviously essential to disclose the existence of any marked divergence in respect of sex and age between the inhabitants of the selected through houses and those of the selected back-to-back houses, and to enable such divergence, to some extent at least, to be taken into account. It was arranged, also, that, in the course of this detailed census, particulars as to rent should be obtained.

In addition, it was also necessary, in order to ascertain the deaths which had occurred among the populations of the selected areas, that the death registers for ten years should be carefully searched, and details as to sex, age, and cause of death extracted.

It became apparent, therefore, that if the work of carrying out these investigations was not to involve the officers of the local authorities undertaking them in an excessive expenditure of time, it would be practicable to select small areas only in any given town, even where the required conditions could be found. It was thus all the more necessary to select areas in as many towns as possible, with a view not only to obtain comparative data from a variety of places, but also to secure a sufficiently large population in the aggregate as their basis.

It may be urged that although this method supplies a number of small instances of comparison between through and back-to-back houses, the data in each instance must be too small to be of value, and that the data so obtained as to back-to-back houses in one town, though comparable with the data as to through houses in the same town, cannot be comparable with those as to through houses in another town, and *vice versa*. This objection is valid so far as the comparison of areas individually is concerned, but it is clear that if in each of several towns the data as to the selected back-to-back houses are comparable with data as to the selected through houses, it must follow that the aggregate of the data are also strictly comparable.

I spent much time in company with medical officers of health and other officials of districts in the West Riding in attempts to discover areas complying with the conditions laid down above. In some towns, of which the most notable was Sheffield, it proved to be impossible to find such an area, while in others it was only with great difficulty and after many studies of maps and visits of inspection that success was attained. The principal difficulty arose in connection with the comparability of the houses themselves. Frequently through houses, though adjacent to or among back-to-back houses, were altogether of a superior class, or were of much more recent construction; sometimes, too, where otherwise comparable houses could be found, they had been in occupation for less than ten years; and so forth. It was inevitable, of course, that neither the newest back-to-back houses with the most modern improvements, nor the newest through houses, could be brought under review.

Eventually areas were chosen in thirteen different towns, and I satisfied myself in each case that the sanitary circumstances of these areas were reasonably good, that they were not subject to unduly unhealthy conditions, and that although, as will presently appear, the average rent of the through houses was greater than

the average rent of the back-to-back houses, the two types of houses were inhabited by working people of similar class and engaged in similar work.

#### V.—HOUSES, RENTS, POPULATION AND MORTALITY IN THE SELECTED AREAS.

In Table I. in the Appendix are set forth the number of houses in each of the areas which were selected for comparison, the average number of persons per house in each area, and the average weekly rent in each area. The total number of houses in all the areas was 3,996, of which 3,865 were occupied at the time the special census was taken, and 131 or rather more than 3 per cent. were unoccupied. Of the occupied houses 1,567 were through houses, and 2,298 back-to-back houses, and of the latter 515 were houses which possessed substantial means of ventilation from the side as well as from the front of the house ("blocks of four"), while the remainder, 1,783, were back-to-back houses in rows which possessed means of window ventilation from the front wall only. The proportion of unoccupied through and back-to-back houses was about the same, rather more than 3 per cent., but the proportion of unoccupied back-to-back houses in rows was somewhat higher—namely, 4 per cent.

The average number of persons per house ranged from 3·4 to 4·9 in the case of through houses, and from 3·3 to 4·1 in the case of back-to-back houses, the average in all the areas being 4·3 and 3·8 respectively. In the case of back-to-back houses with side ventilation the average number per house was a little larger (4·0) than in the other type of back-to-back house.

These figures indicate that the through houses were, on the whole, somewhat more commodious than the back-to-back houses, especially than those built in rows, and this inference is confirmed by comparison of the weekly rents. Notwithstanding the careful exclusion of through houses which were not comparable with the back-to-back houses, the average weekly rent of the through houses was materially higher than that of the back-to-back houses in each of the areas. The average rent in all the areas combined was 5s. 6d. in the case of through houses and 4s. 6d. in the case of back-to-back houses. The average rent of the latter having side ventilation was a little higher and that of back-to-back houses built in rows was a little lower than 4s. 6d.

Another analysis of the details as to weekly rents shows that while the bulk (89 per cent.) of the back-to-back houses were rented at sums ranging from 3s. 6d. to 5s. 6d. per week, the bulk (88 per cent.) of the through houses were rented at 4s. 6d. and upwards.

The populations of the different areas are shown in Table II. in the Appendix. In this table are set forth in detail the number of inhabitants of each area, classified according to sex and age in eleven age groups, and according to their residence

in through or back-to-back houses. The total population of the through houses was 6,784, and that of the back-to-back houses 8,797.

It will be observed from this table that the distribution of the various age groups in the aggregate populations of the two classes of house differs materially. Broadly, these differences consist of a relative excess in the back-to-back houses of the two age groups, under 5 years, and from 25 to 35 years, and in the through houses of a marked relative excess of the age groups from 10 to 25 years, and a less marked excess of the age groups from 45 years and upwards.

The deaths registered as having occurred during the ten years (1898-1907) in the areas were ascertained, as already stated, from the official returns of the registrars of deaths to the medical officers of health of the districts concerned. The necessary searches in these returns were very thoroughly made by the officers of the local authorities, and in several cases the returns were examined more than once in order to ensure that deaths had not been overlooked. The difficulty arising from deaths in public institutions was successfully overcome in most areas, the only important exception in this respect being Morley, in which case I was informed that the tracing of these extraneous deaths of inhabitants of both the through and back-to-back houses was impossible.

In Table III. in the Appendix are set forth in detail the number of deaths thus ascertained to have occurred in each of the areas classified according to sex and age in eleven age groups. This table shows that the total number of deaths recorded in all the areas during the decennium was 2,385.

The average annual crude death-rate of all the areas was therefore 15.3 per 1,000.

In the larger individual areas the crude death-rates per 1,000 in back-to-back and through houses together were:—Leeds, 18.3; Morley, 11.8; Batley, 15.8; Bradford, 16.1; Huddersfield, 15.7; Halifax, 15.3; Keighley, 15.3; and in the remaining smaller areas, collectively, 12.4 per 1,000. These figures indicate that the areas selected were not unhealthy areas.

## VI.—COMPARISON OF MORTALITY IN THROUGH AND BACK-TO-BACK HOUSES.

### (a) *Crude Death Rates.*

Table III. shows that, during the decennium examined, 942 deaths were registered as having occurred among residents of the through houses of the areas as a whole, and that 1,443 deaths were registered as having occurred among residents of the back-to-back houses of these areas. Based on the population found to be occupying the houses in these areas the mean annual crude death-rate from all causes in the through houses as a whole was 13.9 per 1,000, and that in the back-to-back houses as a whole 16.4 per 1,000.

In the larger areas individually and smaller areas collectively these crude death-rates were as follows:—

Table A.—Mean annual crude death-rate from all causes per 1,000.

Area in						Through houses.	Back-to-back houses.
Leeds	...	...	...	...	...	16.03	20.47
Morley	...	...	...	...	...	11.29	12.07
Batley	...	...	...	...	...	11.74	17.71
Bradford	...	...	...	...	...	16.33	16.08
Huddersfield	...	...	...	...	...	15.14	16.51
Halifax	...	...	...	...	...	15.77	14.81*
Keighley	...	...	...	...	...	14.52	16.24
Other areas	...	...	...	...	...	10.21	14.72
All areas	...	...	...	...	...	13.89	16.40

(b) *Death-rates corrected for differences in age and sex constitution.*

The foregoing rates of mortality are crude rates and cannot properly be used for purposes of accurate comparison.

As mentioned previously, in order to make a mathematically complete correction of these crude rates, information would be required as to the age and sex constitution of the populations concerned at the commencement as well as at the end of the decennium for which the death-rates have been calculated. This information it was clearly impossible to obtain, and the question arises how far the information which has been obtained on these points at the end of the decennium is to be relied upon for making the necessary correction.

It is clear that the age and sex constitution as ascertained at the end of the decennium may not and probably does not represent the mean age and sex constitution throughout the decennium. Nevertheless it is not a very wide assumption that the variations in respect of age and sex which were found to exist in the different populations at the end of the decennium reflect with sufficient approach to accuracy the variations which existed throughout that period.

It is permissible, therefore, for the purpose in view to use the figures set forth in Table II. for calculating, in the usual way, factors of correction for the differences in the age and sex constitution. This has accordingly been done, the standard death-rate being calculated for each sex at the various age groups from the mean annual death-rates from all causes in England and Wales during the decennium 1891-1900, as given in the last decennial supplement of the Registrar-General. The factors thus obtained are set forth in Tables XIII. and XIV. in the Appendix.

The death-rate from all causes, when corrected in this way for the differences in age and sex constitution, of the population living

\* Exclusive of the deaths of two persons who had resided in back to back houses in the area selected, for a few weeks only. If these two deaths are included the crude death-rate becomes 15.10. One of these deaths was due to enteric fever, the other to phthisis.

in the through houses, collectively, of all the selected areas, is increased to 16·15 per 1,000, while that of the population living in all the back-to-back houses is increased to 18·60 per 1,000.

There was, therefore, an excess corrected death-rate in the back-to-back houses, collectively, of 15 per cent.

The corrected death-rates of the larger areas individually and of the smaller areas collectively are shown in the following table, as well as the comparative mortality figures, the death-rate in the through houses in each instance being given as 1,000.

*Table B.—Mean annual death-rates from all causes, corrected for differences in sex and age constitution.*

Areas in	Death-rate per 1,000, corrected for differences in sex and age constitution.		Comparative mortality, the death-rate in through houses being 1,000 in each case.	
	Through houses.	Back-to-back houses.	Through houses.	Back-to-back houses.
Leeds	20·12	23·45	1,000	1,166
Morley	13·80	14·02	1,000	1,016
Batley	13·05	19·36	1,000	1,484
Bradford	17·81	19·66	1,000	1,104
Huddersfield	16·20	17·52	1,000	1,081
Halifax	17·49	17·16*	1,000	981°
Keighley	16·05	18·12	1,000	1,129
Other areas...	11·74	15·78	1,000	1,344
All areas	16·15	18·60	1,000	1,152

It will thus be observed that with the exception of the area in Halifax, in which the two sets of rates were nearly identical, there was an excess death-rate in the back-to-back houses in each of the areas chosen for comparison. In the case of Morley the excess was less than 2 per cent., but in the other areas it ranged from 8 per cent. to 48 per cent.

It must be borne in mind, however, that with the exception of the area in Leeds, none of the areas is large enough for reliable *individual* comparison. In the case of Leeds the populations of the through and back-to-back houses numbered about 2,000 each, but in each of the remaining areas the population was less than 1,000 in either the through houses or in the back-to-back houses, or in both, and there is consequently scope for considerable range of accidental variations in all these cases. The extension of the statistics over so long a period as ten years has, however, the same effect as if each population had been multiplied by ten, and the practically uniform indication of the individual statistical results obtained adds greatly, therefore, to their significance when taken in the aggregate.

\* Exclusive of two deaths referred to in footnote on page 15. Including these two deaths the corrected death-rate is 17·49.

VII.—COMPARISON OF MORTALITY IN VARIOUS TYPES OF BACK-TO-BACK HOUSES.

I have already referred to the necessity of obtaining data for comparing, with through houses, two types in particular of back-to-back houses—namely, those with, and those without, means of window ventilation other than that provided from the front wall of the house. In Leeds it was contended that even back-to-back houses in rows, as built under modern conditions, are not unhealthy, but in other towns it was argued that, although such houses might be unhealthy, it could not reasonably be maintained that back-to-back houses built in blocks of four materially differed from through ventilated houses. The fact that in the latter type of back-to-back house currents of air can pass from the side to the front of the house, was claimed not only as a point in their favour, but as a substantial reason for regarding such houses, *quâ* ventilation, as much more akin to through houses than to the ordinary type of back-to-back house. Steps were, therefore, taken where possible to select areas which contained back-to-back houses built in blocks of four, and this proved to be feasible in six towns—namely, Morley, Batley, Bradford, Huddersfield, Halifax, and Keighley. The population inhabiting these side ventilated back-to-back houses was 2,045, while the deaths which occurred in them during the decennium dealt with numbered 278.

The influence of these side ventilated back-to-back houses on the rates of mortality may be ascertained in two ways—either by excluding both their population and deaths from the calculations, thus making the comparison one between through houses and back-to-back houses built in rows only; or, by instituting a direct comparison among the three classes of houses confined to the areas which contained the back-to-back houses built in blocks of four.

Factors for correcting the crude death-rates obtained by the former method have been calculated, and the following figures show the corrected death-rates in each area and comparative mortality. The factors are shown in the Appendix, Tables XII. and XIII.

Table C.—Mean annual death-rates from all causes, corrected for differences in sex and age constitution, in through houses and back-to-back houses built in rows.

Areas in	Corrected death-rate from all causes.		Comparative mortality figures.	
	Through.	Back-to-back, excluding those having side ventilation.	Through.	Back-to-back, excluding those having side ventilation.
Leeds ... ...	20.12	23.45	1,000	1,166
Morley ... ...	13.80	13.81	1,000	1,001
Batley ... ...	13.05	21.50	1,000	1,648
Bradford ... ...	17.81	20.32	1,000	1,141
Huddersfield ... ...	16.20	19.20	1,000	1,185
Halifax ... ...	17.49	18.29	1,000	1,046
Other areas... ...	11.74	15.78	1,000	1,344
All areas ...	16.15	19.47	1,000	1,206

Comparing the general results of Tables B and C it will be seen that the comparative mortality figure of back-to-back houses, excluding those having means of side ventilation, is 1,206, in all the areas combined, while in all back-to-back houses it is 1,152, a difference of upwards of 5 per cent. The average death-rate from all causes among the population of back-to-back houses built in blocks of four must, therefore, have been appreciably less than that among the population of back-to-back houses built in rows.

Further indication of this difference is furnished by a direct comparison of the areas containing back-to-back houses in blocks of four. The populations of these areas are shown in detail in Table IV. in the Appendix, and the deaths recorded as having occurred among them in Table V. in the Appendix. These data are so small in each area, individually, that they must be used collectively.

The population living in the through houses in these areas numbered 3,126, while that living in the back-to-back houses, built so as to admit of side ventilation, numbered 2,045, and that living in the back-to-back houses not allowing of such side ventilation, numbered 3,099. The deaths recorded during the decennium 1898-1907 as having occurred among these houses numbered 429, 278, and 493, respectively. The crude death-rates per 1,000 were, therefore, 13.72 for the through houses, 13.59 for the back-to-back houses in blocks of four, and 15.91 for the back-to-back houses in rows, while for all back-to-back houses in these areas it was 14.99. When these death-rates are corrected for differences of sex and age constitution, they become as follows:

*Table D.—Corrected death-rates of populations living in areas containing back-to-back houses with side ventilation.*

	Corrected death-rate from all causes.	Comparative mortality figures.
Through houses	15.51	1,000
Back-to-back houses with side ventilation	15.69	1,012
Back-to-back houses without side ventilation	17.94	1,157
Both types of back-to-back house	17.06	1,100

Judging by the limited statistical data available, it appears, therefore, that the corrected death-rate from all causes in back-to-back houses built so as to admit of ventilation from the side as well as from the front of the house, approximated closely to the corrected death-rate in through houses, while there was a marked excess of mortality in the back-to-back houses built in rows.

#### VIII.—CAUSES OF DEATH.

In the preceding pages, the comparison which has been made between mortality in through and in back-to-back houses has related to mortality from all causes together. Having demonstrated that the rate of mortality from all causes in back-to-back houses shows a definite excess, it is now necessary to ascertain, if

possible, whether this excess is attributable to any and, if so, what particular causes of death, and also whether these causes are such as may reasonably be regarded as likely to have been influenced by the character of the dwelling.

For this purpose, I have tabulated all the deaths, registered as having occurred among residents of the areas, according to cause, as well as according to age and sex, separate tabulating sheets being used for each area.

From these tabulating sheets Tables VI. to XII. in the Appendix have been prepared. In Tables VI. and VII. are set forth the number of deaths from several causes, as well as from all causes, which occurred among residents of the through houses and back-to-back houses, respectively, of the areas collectively, classified according to sex and age in 11 age groups.

In Tables VIII., IX., and X. are similarly recorded the principal causes of death in the areas containing back-to-back houses with means of side ventilation.

Lastly, in Table XII. are set forth the crude death-rates per 1,000, from the principal causes or groups of causes, as calculated from the figures in the foregoing tables, and from the population figures in Tables II. and IV.

*(a.) Causes of Death in all the Areas collectively.*

Table XII. (a), relating to all the areas, shows that the predominant causes of death which accounted for the excess crude death-rate in back-to-back houses were:—

- (1) the group of common infectious diseases;
- (2) diarrhoea;
- (3) pneumonia, bronchitis, and other pulmonary diseases (excluding phthisis); and
- (4) Certain infantile causes of death, which may for convenience be grouped together under the heading "developmental." These comprise premature birth, congenital defects, atrophy, debility, marasmus, convulsions, and teething.

To a smaller extent, and only in back-to-back houses without side ventilation, mortality from phthisis also contributed to the excess.

The crude death-rate in back-to-back houses was in greatest excess in the group of developmental causes of death, in respect of which it amounted to as much as from 85 to 105 per cent. In the case of pulmonary diseases, the crude death-rate in back-to-back houses was from 39 to 46 per cent. in excess, while for the group of infectious diseases and diarrhoea, the excess ranged from 34 to 50 per cent. The crude death-rate from phthisis, though identical in through houses and the aggregate of all back-to-back houses, was 11 per cent. higher in back-to-back houses in rows.

The death-rates relating to separate causes of death in Table XII. are, however, uncorrected for differences in the age and sex constitution of the populations concerned, and, therefore, cannot be accurately compared. In order to make allowance for these disturbing differences, I have calculated factors of correction for the several populations for mortality from phthisis, for that from pneumonia, bronchitis, and other pulmonary diseases, and for that

from the group of infectious diseases, on the basis of the death-rates from these diseases in England and Wales during the decennium 1891-1900, as given in the last decennial supplement of the Registrar-General. The factors are set forth in Table XIII. (Appendix).

The result of correction, for differences in sex and age constitution, of the rates of mortality from these diseases is shown in the following table. The figures in brackets indicate the relative mortality, that in through houses being taken, in each case, as 100:—

*Table E.—Showing for all the areas, the mean annual corrected death-rate per 1,000 at all ages, and the relative mortality, in through and back-to-back houses from (a) pulmonary diseases, (b) infectious diseases, and (c) phthisis.*

—	Through houses.	Back to-back houses.	Back-to-back houses, excluding those having side ventilation.
(a) Pulmonary diseases (excluding phthisis).	3.16 (100)	4.26 (135)	4.44 (141)
(b) Infectious diseases ...	1.35 (100)	1.49 (110)	1.60 (119)
(c) Phthisis ... ...	1.15 (100)	1.15 (100)	1.29 (112)

While, therefore, excess mortality in back-to-back houses is slightly increased by correction for age and sex in the case of phthisis, and slightly reduced in the case of pulmonary diseases, it is reduced very materially in the case of the group of infectious diseases, the excess now being 10 to 19 per cent., instead of 35 to 50 per cent.

The disturbing effect of differences in sex and age distribution on mortality from diarrhoea, and the group of developmental causes of death, may be excluded by contrasting the death-rates from these causes at the age period under five years, which is almost solely concerned in these causes of death. These death-rates are as follows, the figures in brackets indicating the relative mortality, that in the through houses being 100 in each case:—

*Table F.—Showing for all the areas, the mean annual death-rates, per 1,000 living under five years of age, in through and back-to-back houses, from (a) diarrhoea, and (b) developmental causes of death.*

—	Through houses.	Back-to-back houses.	Back-to-back houses, excluding those having side ventilation.
(a) Diarrhoea ... ... ...	8.1 (100)	8.5 (105)	8.0 (99)
(b) Developmental causes of death.	16.4 (100)	22.6 (138)	24.2 (148)

These figures indicate that there was but little difference between through and back-to-back houses in regard to mortality

from diarrhoea, but that the corrected excess mortality in back-to-back houses from the developmental causes of death ranged from 38 to 48 per cent.

Summarising the foregoing analysis of the causes of death in the areas collectively, it appears, therefore, that, after making allowance for differences in the age and sex constitution of the populations concerned, the outstanding causes of the higher general death-rate in the back-to-back houses are to be found in the excess mortality from pulmonary diseases, and from the group of developmental causes of death; and to a smaller degree in an excess of mortality from the group of infectious diseases, and, in the case of back-to-back houses built in rows, from phthisis also. A summary of the figures is as follows:—

*Table G.—Showing the excess mortality per cent. from the causes which principally contributed to the higher corrected general death-rate in (a) back-to-back houses of all kinds, and (b) in back-to-back houses exclusive of those having side ventilation, as compared with through houses, in the selected areas as a whole.*

Excess mortality per cent. from	(a) In all back-to-back houses.	(b) In all back-to-back houses built in rows.
Developmental causes of death ... ...	38%	48%
Pulmonary diseases (excluding phthisis)	35%	41%
Phthisis ... ... ...	—	12%
Infectious diseases ... ... ...	10%	18%

(b.) *Causes of death in the area in Leeds.*

A comparison of the causes of death in each of the areas would serve but little useful purpose, because the data are too small; but in the case of Leeds, this objection is less applicable, and the figures for the area selected in that town have been calculated separately with the following results:—

*Table H.—Showing for the area in Leeds, the mean annual corrected death-rates and relative mortality from certain causes of death in through and back-to-back houses.*

—	Through houses.	Back-to-back houses.
<i>1. At all ages.</i>		
(a) Pulmonary diseases (excluding phthisis)	4.65 (100)	5.74 (123)
(b) Infectious diseases ... ... ...	1.51 (100)	1.93 (128)
(c) Phthisis ... ... ...	1.22 (100)	1.40 (115)
<i>2. Under 5 years of age.</i>		
(d) Diarrhoea ... ... ...	12.2 (100)	8.2 (67)
(e) Developmental causes of death ...	21.2 (100)	24.5 (116)

(c.) *Causes of death in the areas containing Back-to-back Houses with Side Ventilation.*

The rates of mortality from various causes in the areas containing back-to-back houses built so as to admit of side ventilation may also be compared. It must be borne in mind, however, that the data are small, and that the liability to error is large in consequence.

The crude death-rates from different causes in these areas are set forth in Table XII. (b) in the Appendix, from which it will be observed that although the mortality from all causes was about the same in through houses and in back-to-back houses with side ventilation, nevertheless, the crude death-rates from diarrhoea, from pulmonary diseases, and from the group of developmental causes of death were in considerable excess in the latter and in still greater excess in back-to-back houses without side ventilation. On the other hand, the crude death-rates from phthisis and from the group of infectious diseases, though highest in back-to-back houses without side ventilation, were lowest in back-to-back houses with side ventilation.

It has already been explained that the death-rates from different causes in Table XII. are uncorrected for differences in the sex and age constitution of the populations concerned. The following figures show the death-rates from the causes, now in question, corrected for these differences, in the manner described when discussing the causes of death in all the areas. The factors are shown in Table XIII. in the Appendix.

*Table J. — Showing for areas, containing back-to-back houses with side ventilation, the mean annual corrected death-rates, and the relative mortality from certain causes of death.*

	Through houses.	Back-to-back houses having side ventilation (blocks of four only).	Back-to-back houses without side ventilation (rows only).	All back-to-back houses.
<i>1. At all ages.</i>				
(a) Pulmonary diseases (excluding phthisis).	2.62 (100)	3.66 (140)	4.08 (156)	3.92 (150)
(b) Phthisis ... ...	1.06 (100)	0.74 (70)	1.23 (116)	1.03 (97)
(c) Infectious diseases ...	1.29 (100)	1.00 (78)	1.13 (88)	1.08 (84)
<i>2. Under 5 years of age.</i>				
(d) Diarrhoea ... ...	7.23 (100)	10.58 (146)	9.27 (128)	9.78 (135)
(e) Developmental causes of death.	15.74 (100)	16.40 (104)	26.49 (168)	22.61 (144)

The figures in this table are in accord with those in Tables E and F, for all the areas, in demonstrating that two groups of disease, namely, (1) pulmonary diseases, other than phthisis, and (2) the group of developmental causes of death were responsible, in outstanding fashion, for the excess mortality in back-to-back houses.

On the other hand, the figures in Table J indicate a much higher mortality from diarrhoea and a much lower mortality from

the infectious diseases in back-to-back houses than the corresponding figures in Tables E and F. In these respects the figures of the tables differ considerably, but when it is borne in mind that in regard to mortality from these two groups of disease, more must depend on opportunities for infection, that is to say, on accidental circumstances, than on the precise nature of the environment, it is not surprising that there should be such discrepancies in two given sets of figures, more particularly when the data are not very large.

In the case of phthisis mortality, the figures in the tables agree in showing a material excess in back-to-back houses without side ventilation, but Table J shows a much more favourable record as to mortality from this disease in the back-to-back houses with side ventilation than in through houses.

*(d). Deductions from statistics as to causes of death.*

In regard to mortality from phthisis, the foregoing statistics confirm the results obtained by Dr. Niven in his Manchester investigation, referred to on page 7. His results showed that there was "not that marked preponderance of phthisis (in back-to-back houses) which we should expect from previous investigations." The mean excess mortality from phthisis in back-to-back houses amounted to 11 per cent. in Dr. Niven's investigation, as compared with 12 per cent. (in back-to-back houses in rows) in the present investigation.

It remains to be considered whether the mortality from pneumonia, bronchitis, and other pulmonary diseases, and from the group of developmental causes of death, as to the excess of which in back-to-back houses the figures admit of no doubt, may be regarded as reflecting the influence of back-to-back houses as such.

Most observers who have inquired into this question have found an excess mortality from pulmonary diseases in back-to-back houses, and it has been assumed by them that such excess is related to the absence of the free ventilation in these houses that can be obtained in through houses. If this assumption be considered to be sound, as probably it may be, the fact that the same excess has been found in the present inquiry is significant, since so much care was taken to select back-to-back houses of a good type only. It may be added that, in this inquiry, the excess of mortality from diseases of the lung in back-to-back houses involved pneumonia and bronchitis to about an equal extent.

The excess mortality from the developmental causes of death in back-to-back houses, which is so prominent a result of the analysis of the statistics obtained in the present inquiry, has not been established, so far as I know, in any previous inquiry of this kind. Dr. Niven showed, however, in his inquiry that there was a marked excess of mortality from all causes at early ages in back-to-back houses; and in my report on the Whickham urban district, I demonstrated that there had been a large excess of infantile mortality per 1,000 births in the back-to-back houses.

The causes of death grouped together under the term "developmental" are of considerable importance. They account for no less than about one-third of the total deaths under 5 years of age, but their exact significance is somewhat

difficult to estimate. They include causes of death, such as premature birth and congenital defects, which are directly related to purely pre-natal influences, as well as causes relating to influences affecting adversely the child post-natally, and in the latter category there are included, no doubt, deaths which, with more accurate certification, might have been assigned to more definite causes. Nevertheless, these latter causes of death—atrophy, debility, marasmus, convulsions, teething are associated, on the whole, more closely than any other group of causes, with the effects of impaired nutrition, imperfect growth, and abnormal development of the young child. The conditions which produce such effects are many and complex, but it can scarcely be doubted that in the earliest period of life, the nature of the home, especially perhaps its facilities for obtaining fresh air and sunlight, must exert a powerful influence.

If the death-rates from this group of causes of death be analysed, it will be found that, in the aggregate of the areas, the excess mortality in back-to-back houses from premature birth and congenital defects was comparatively small (5 to 14 per cent.), while that from the remaining causes was very large (64 to 79 per cent.). Indeed, in Leeds, and in the areas containing back-to-back houses with side ventilation, mortality ascribed to premature birth was in excess in the through houses. The figures are as follows:—

*Table K.—Showing death-rates from certain infantile causes of death, per 1,000 living under 5 years of age, in through and back-to-back houses, in (1) all the areas, (2) the areas containing back-to-back houses with side ventilation, and (3) the area in Leeds. Figures in brackets represent the relative mortality, that in through houses being 100 in each case.*

	Premature birth and congenital defects.	Atrophy, debility and "marasmus."	Convulsions and dentition.
<i>1. All areas</i>			
Through houses ... ... ..	7.7 (100)	4.5 (100)	4.2 (100)
Back-to-back houses ... ... ..	8.1 (105)	7.6 (169)	6.9 (164)
Back-to-back houses, excluding those having side ventilation.	8.8 (114)	7.9 (176)	7.5 (179)
<i>2. Areas containing back-to-back houses in blocks of four.</i>			
Through houses ... ... ..	7.7 (100)	4.3 (100)	3.8 (100)
Back-to-back houses with side ventilation.	5.3 (69)	6.3 (147)	4.8 (126)
Back-to-back houses without side ventilation.	12.9 (168)	7.9 (184)	5.6 (147)
<i>3. Area in Leeds.</i>			
Through houses ... ... ..	10.1 (100)	5.8 (100)	5.3 (100)
Back-to-back houses ... ... ..	4.6 (46)	9.6 (166)	10.3 (194)

A not unreasonable inference from this table would be that while back-to-back houses may have a deleterious influence, prenatally, on infant life, they exert a much more powerful injurious influence on the nutrition and development of the young child after birth.

It may be added that of other causes of death at this age period (under 5 years), two groups of disease only showed an excess of mortality in back-to-back houses (apart from the small excess from diarrhoea shown in Table F), namely, the infectious diseases and pulmonary diseases. In the case of the infectious diseases, the excess of mortality, under 5 years of age, in back-to-back houses amounted to 28 per cent. in all the selected areas, and in the case of pulmonary diseases, to 62 per cent. In Leeds alone, the excess mortality, under 5 years of age, from these two groups of diseases in back-to-back houses was 27 and 54 per cent. respectively.

#### IX.—AGES AT DEATH.

Having considered the rates of mortality at all ages, and ascertained the causes of death which chiefly accounted for the excess of mortality in back-to-back houses, a comparison may be made briefly of the rates of mortality at different ages in the two types of house.

The ages at which death occurred from all causes and from certain specified causes are shown in the Appendix in Tables VI. to X., classified in 11 age groups. In order to avoid, to some extent, errors due to the smallness of the data at some of the age groups, the death-rates in the following table have been calculated for six instead of 11 age groups as shown in these detailed tables.

*Table L.—Showing for all the areas, the approximate death-rates from all causes per 1,000 living at six groups of ages in (a) through houses, (b) back-to-back houses, and (c) back-to-back houses, excluding those having side ventilation.*

Age groups.	Under 5.	5-15	15-25	25-45	45-65	65 and upwards	All ages.*
(a) Through houses ...	51.3	3.7	5.3	4.7	18.3	91.6	16.2
(b) Back-to-back houses ...	65.7	4.4	3.9	5.5	19.1	107.1	18.6
(c) Back-to-back houses, excluding those having side ventilation.	66.6	4.8	3.5	6.0	20.0	118.3	19.5

This table shows that there was a higher rate of mortality from all causes in back-to-back houses than in through houses at every age group, with but one exception, and also that, with the same exception, the rate of mortality was still higher in the back-to-back houses built in rows. It may be noted that in the case of the exceptional age group, 15 to 25, the data are very small, the deaths numbering but six or seven per annum.

The age groups might be combined into even wider age groups for purposes of approximate comparison, and if this is done, it will

\* Corrected for age and sex distribution.

be found that in the three types of house, viz., all through houses, all back-to-back houses, and all back-to-back houses in rows, the relative death-rates of persons living at ages under 15 were as 100: 151: 156, respectively; at ages 15-45, as 100: 102: 106; at ages 45-65, as 100: 104: 109; and at ages 65 and upwards, as 100: 117: 129.

It would appear, therefore, from these figures that the effect of back-to-back houses is manifested chiefly at the two extremes of ages, and most of all in infancy and childhood.

It is of interest to compare these results with those obtained by Dr. Niven in the Manchester investigation already referred to. The following table in Dr. Niven's annual report for 1894 is, therefore, reproduced:—

*Table M.—Showing, for selected districts in Manchester, the mean annual death-rates from all causes during 1891-1894 per 1,000 living at various groups of ages, in (a) all houses in the areas, and in (b) the back-to-back houses only in the areas.*

—	Under 1 year.*	1-5°	5-15	15-25	25-45	45-65	65 and upwards	All ages.
(a) All houses ...	279.1	55.7	5.9	6.2	15.9	45.8	139.1	30.3
(b) Back - to - back houses.	299.9	63.8	7.2	7.3	15.9	49.7	172.4	37.0

These rates differ from those obtained in the present inquiry in that all of them are much higher, and that the only age group which does not show an excess of mortality in back-to-back houses is 25 to 45 and not 15 to 25.

On the other hand, there is much similarity in regard to the approximate relative excess of mortality in back-to-back houses at the various age groups in the two inquiries. Thus, by combining the age groups into the four larger age groups used above, it will be found that, in Dr. Niven's inquiry, the excess mortality in back-to-back houses at the age groups under 15, 15 to 45, 45 to 65, and 65 and upwards, amounted to 33 per cent., 10 per cent., 9 per cent., and 24 per cent., respectively. In the present inquiry, as shown above, the corresponding excess per cent. in back-to-back houses in rows was 56, 6, 9, and 29, respectively.

Although, therefore, it is obvious that the houses brought under review by Dr. Niven and in the present investigation differed widely in healthiness, both inquiries agree closely in showing that the excess of mortality in back-to-back houses affects predominantly the early ages of life under 15 and the late ages over 65, and that it affects the intervening ages to, comparatively, a minor extent.

As regards the causes of death which chiefly contributed to the excess of mortality in back-to-back houses at the two extremes of life, it has been demonstrated already (p. 25) that at the early ages of life pulmonary diseases, other than phthisis, and the group of developmental diseases were mainly responsible for this excess, aided somewhat by the infectious diseases. At

\* The death-rates for the age period 0-5 were (a) 106.7 and (b) 119.0.

the late ages, analysis of the tables will show that mortality from pulmonary diseases, other than phthisis, again constituted the outstanding cause of the excess of mortality in back-to-back houses.

#### X.—SUMMARY AND CONCLUSIONS.

The principal points of the foregoing report may be summarised as follows:—

1. The comparison which has been made between through houses and back-to-back houses has been carried out so as to bring under review good types only of back-to-back houses, situated in healthy areas.
2. The through houses and back-to-back houses thus compared were situated in 13 industrial towns in the West Riding of Yorkshire.
3. Every care was taken to select strictly comparable through and back-to-back houses, occupied by the same class of people, with similar occupations and wages. Nevertheless, the rent of the through houses was, on the average, appreciably higher than that of the back-to-back houses—the average rent of the former being 5s. 6d., and of the latter, 4s. 6d. per week.
4. The vital statistics which have been obtained regarding these areas, cover a period of 10 years (1898-1907); and, on the basis of a special detailed census of each area, corrections have been made, throughout, for differences in the age and sex constitutions of the populations concerned.
5. The corrected average annual death-rate from all causes was greater in the back-to-back houses than in the through houses, to the extent of 15 per cent.
6. The excess of mortality in back-to-back houses built in continuous rows was greater still, amounting on the average to a little more than 20 per cent.
7. The corrected average annual death-rates from all causes in through houses and in back-to-back houses possessed of means of side ventilation (blocks of four), were about equal.
8. The outstanding causes of death which produced the excess of mortality in back-to-back houses were
  - (a) pneumonia, bronchitis and other pulmonary diseases (exclusive of phthisis), and
  - (b) diseases of defective development and of malnutrition in young children.
9. The corrected excess of mortality from each of these two groups of diseases, in back-to-back houses, approached 40 per cent.
10. Mortality from phthisis showed an excess, amounting to 12 per cent., in back-to-back houses built in rows, but not in back-to-back houses built so as to admit of side ventilation (blocks of four).

11. Although the average rate of mortality from all causes was about the same in through houses and in back-to-back houses built in blocks of four, there was a large excess of mortality in the latter from pulmonary diseases (exclusive of phthisis), as was the case in back-to-back houses in rows, and also a large excess of mortality from the diseases (except premature birth) of defective development and malnutrition in children.

12. Approximately, the ages at which the excess of mortality in back-to-back houses occurred were the early ages of life from infancy up to 15 years, and the late ages of life from 65 years and upwards. At both of these periods of life, the predominating cause of the excess was mortality from pulmonary diseases, and at the early ages, as well, from diseases of defective development and malnutrition.

13. At the age periods intervening between these two extremes, the relative excess of mortality in back-to-back houses was comparatively small.

On the whole, therefore, it is reasonable to infer from the data given in this report that, even in good types of back-to-back houses situated in healthy areas, the mortality from all causes is higher by 15 to 20 per cent. than in comparable through houses; but that this excess is not evident in back-to-back houses built with means of side ventilation.

Furthermore, it may likewise be inferred that the chief sufferers from residence in back-to-back houses are infants, young children, and old persons, in consequence, principally, of the greatly increased liability of both young and old to death from pulmonary diseases (other than phthisis), and, of the young, to death from diseases resulting from defective development and malnutrition.

In concluding this report, I wish to emphasise, what I indicated at the outset, how much I have been indebted to the officials of the local authorities for their careful and most cordial assistance to me in the preliminary stages of my investigation, and to them all I again offer my warmest thanks.

L. W. DARRA MAIR.

## APPENDIX.

TABLE I.—Showing, for through houses and back-to-back houses, in each of the selected areas and in all the areas combined, the number of occupied and unoccupied houses, the average number of persons per house, and the average rent per week.

TABLE II.—*Population* ascertained to be living in 1908 in each of the areas in (A) Through houses and (B) Back-to-back houses, classified according to age and sex in 11 age groups; also, the total population and the proportional population per 1,000 at all ages, at each age group, in all the areas combined.

## A.—*Through Houses.*

TABLE II.—*continued.*

### B.—*Back-to-Back Houses.*

TABLE III.—*Deaths* from all causes, registered as having occurred, during the decennium 1898-1907, among residents of (A) Through houses and (B) Back-to-back houses in each of the selected areas, classified by age and sex in 11 age groups.

## A. — *Through Houses.*

TABLE III.—*continued.*

## B.—*Back-to-Back Houses.*

TABLE IV.—*Population living in each of the selected areas which contained back to back houses with side ventilation, in (A) Through houses, (B) Back-to-back houses with side ventilation, and (C) Back-to-back houses without side ventilation, classified in 11 age groups.*

Ages.	A.—Through Houses.											All Ages.																	
	Under 5.			5-10.			10-15.			15-20.			20-25.			25-35.			35-45.			45-55.			55-66.			65-75.	
Sex.	M.	F.	M.	M.	F.	M.	M.	F.	M.	M.	F.	M.	M.	F.	M.	M.	F.	M.	M.	F.	M.	M.	F.	M.	M.	F.			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)		
Morley	...	...	25	33	43	43	52	43	64	47	57	67	55	68	50	52	22	23	7	21	3	3	417	433	433	433	433		
Batley	...	...	27	21	28	17	16	27	19	30	30	30	49	55	38	41	28	33	12	22	9	9	2	2	258	287	287	287	287
Bradford	...	...	8	12	11	11	15	15	13	5	11	22	25	24	30	15	17	10	17	4	7	2	1	131	163	163	163	163	
*Huddersfield	...	...	20	14	15	17	17	15	25	15	15	21	35	41	31	39	19	16	11	16	5	13	—	6	193	213	213	213	213
*Halifax	...	...	19	11	23	16	14	23	21	18	18	14	27	46	28	30	15	13	9	12	5	4	2	2	181	189	189	189	189
†Keighley	...	...	18	27	37	38	31	28	47	43	39	43	47	46	43	25	29	23	36	14	15	3	4	306	355	355	355	355	
Total	...	...	...	...	117	118	141	141	143	148	160	166	175	162	233	281	222	251	152	160	87	126	44	69	12	18	1,486	1,640	
Total (both sexes)	...	...	235	282	291	326	337	514	473	312	213	113	30	—	—	—	—	—	—	—	—	—	—	—	—	—	3,126	3,126	

B.—Back-to-Back Houses with Side Ventilation.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)				
16112	Morley	...	...	28	18	27	26	27	26	33	34	33	32	30	45	30	37	19	21	1	7	4	2	277	332				
	Patley	...	...	21	20	26	16	24	16	25	53	64	45	46	27	32	9	16	9	4	3	2	247	278					
	Bradford	...	...	...	8	13	14	9	13	8	8	7	8	20	28	12	17	9	10	4	7	2	1	97	112				
	* Huddersfield	...	...	...	1	6	3	5	2	5	7	5	4	4	10	9	7	10	3	5	4	3	—	43	53				
	* Halifax	...	...	...	2	6	1	1	3	5	4	8	3	8	9	12	2	4	6	7	3	4	3	—	37	58			
	† Keighley	...	...	...	27	31	31	32	20	14	18	19	23	18	55	53	40	43	22	27	10	14	2	9	3	—	251	260	
	Total	...	...	...	...	87	102	93	100	81	82	85	96	93	106	180	226	157	165	97	119	49	65	20	27	10	5	952	1,093
	Total (both sexes)	...	...	189	193	163	181	199	199	406	322	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	2,045	

C.—Back-to-back Houses without Side Ventilation.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)			
16112	Morley	...	...	45	63	55	47	54	50	39	43	30	98	69	73	49	53	18	24	10	15	1	4	467	531			
	Patley	...	...	31	44	18	24	23	20	22	27	30	60	76	40	39	36	35	13	26	9	12	3	—	281	346		
	Bradford	...	...	31	39	32	38	37	44	39	41	44	49	83	82	66	84	33	50	29	30	3	14	—	5	397	476	
	* Huddersfield	...	...	13	14	8	11	9	10	9	11	7	11	21	15	14	27	12	7	5	6	1	2	106	126			
	* Halifax	...	...	10	12	13	14	11	13	13	22	19	30	32	32	22	29	25	24	11	19	5	10	1	2	162	207	
	Total	...	...	...	130	172	126	157	128	143	135	146	136	163	276	303	211	252	155	174	78	106	32	57	6	13	1,413	1,686
	Total (both sexes)	...	...	302	283	271	281	299	299	579	463	329	184	89	89	19	19	19	19	19	19	19	19	19	19	19	3,099	

\* In Huddersfield and Halifax two separate areas were selected, but only one of these areas, in each case, contained back-to-back houses with side ventilation. The figures in this table relate to these areas alone.

† The area selected in Keighley did not contain back-to-back houses without side ventilation.

TABLE V.—*Deaths* from all causes, during the decennium 1898-1907, among residents of each of the selected areas which contained back-to-back houses with side ventilation, classified by age and sex in 11 age groups.

A. — *Through House.*

B.—Back-to-Back Houses with Side Ventilation.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)			
Morley	...	...	...	19	14	1	2	2	1	1	1	1	1	1	1	1	1	4	5	1	1	37	36				
Batley	...	...	...	14	17	1	1	1	1	1	1	1	1	1	1	1	1	6	1	2	1	26	48				
Bradford	...	...	...	8	3	1	—	—	—	—	—	—	—	—	—	—	—	3	2	—	—	19	11				
* Huddersfield	...	...	...	1	2	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	3				
Halifax	...	...	...	1	1	—	—	—	—	—	—	—	—	—	—	—	—	1	2	1	1	4	6				
Keighley	...	...	...	21	18	—	—	—	—	—	—	—	—	—	—	—	—	2	7	2	6	4	45				
Total	...	...	...	64	54	3	3	3	2	3	5	7	2	6	3	11	6	10	11	13	14	16	20	7	8	127	151
Total (both sexes)	...	...	...	118	6	5	12	8	—	—	—	—	—	—	—	—	14	16	24	30	30	30	30	15	27	233	

C.—Back-to-Back Houses without Side Ventilation.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)					
Morley	...	...	...	...	...	32	18	2	7	3	2	1	1	1	1	1	2	4	6	3	3	1	14	3	1	72	47		
Batley	...	...	...	...	...	32	31	1	—	2	1	1	1	1	1	1	—	2	4	6	5	7	3	9	7	5	64	66	
Bradford	...	...	...	...	...	32	26	7	2	—	2	1	3	1	1	1	—	3	2	7	7	5	9	10	10	3	5	67	67
* Huddersfield	...	...	...	...	...	6	11	—	3	—	—	—	1	1	1	1	—	3	2	2	2	2	2	2	2	2	30	30	
Halifax	...	...	...	...	...	9	3	—	1	2	—	—	1	1	2	2	—	2	2	2	2	2	5	6	3	2	27	23	
Total	...	...	...	...	...	111	89	10	12	4	8	4	4	5	4	11	22	8	21	17	14	32	25	40	25	18	9	260	233
Total (both sexes)	...	...	...	...	...	200	22	12	8	9	9	33	29	31	57	65	27	65	27	65	27	65	27	65	27	493			

\* See footnote to Table IV.

† Ditto.

TABLE VI.—Deaths of Residents of the Thurcroft Houses in all the Areas, collectively, from all causes and from certain specified causes, during the decennium 1898-1907, classified by Age and Sex in 11 Age Groups.

	0-5.		5-10.		10-15.		15-20.		20-25.		25-35.		35-45.		45-55.		55-65.		65-75.		75 and upwards.		All Ages.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Small pox	..	..	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Measles	..	..	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2
Scarlet fever	..	..	9	3	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Whooping-cough	..	..	5	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Diphtheria	..	..	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Enteric fever	..	..	24	18	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Diarrhoea	..	..	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lobar Pneumonia	..	..	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bronchitis	..	..	13	8	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Not defined	..	..	4	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Other diseases of Chest (except Phthisis).	..	..	7	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Phthisis.	..	..	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Other Tubercular diseases.	..	..	15	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Malignant diseases..	..	..	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Diseases of Heart.	..	..	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Diseases of Blood-vessels	..	..	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Diseases of Nervous system	..	..	4	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Digestive system	..	..	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Premature birth	..	..	17	12	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Congenital defects..	..	..	9	3	12	12	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Atrophy, Debility, and "Marasmus."	..	..	12	12	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Convulsions	..	..	12	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Teething	..	..	13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Old Age	..	..	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Violence	..	..	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Other Causes	..	..	6	5	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
All Causes	..	..	158	114	16	10	12	10	13	10	12	10	13	10	12	10	13	10	12	10	13	10	12	10
Total (both sexes) .. ..	272	26	22	32	40	39	61	39	60	44	45	67	68	64	69	133	133	133	133	133	133	133	133	133

TABLE VII.—Deaths of Residents of the BACK-TO-BACK HOUSES in all the Areas, collectively, from all causes and from certain specified causes, during the decennium 1898-1907, classified by Age and Sex in 11 Age Groups.

TABLE VIII.—Deaths of Residents in the areas which contained *back-to-back houses with side ventilation*, from all causes and from certain specified causes, during the decennium 1898-1907, classified by Age and Sex in 11 Age Groups.

Deaths in the Through Houses in these areas.

TABLE IX.—Deaths of residents in the *area* which contained *buck-to-buck houses with side ventilation*, from all causes and from certain specified causes, during the decennium 1898-1907, classified by Age and Sex in 11 Age Groups.

Deaths in the BACK-TO-BACK HOUSES WITH SIDE VENTILATION in these areas.

TABLE X.—Death of residents in the areas which contained *back-to-back houses with side ventilation*, from all causes and from certain specified causes, during the decennium 1898-1907, classified by Age and Sex in 11 Age Groups.

Deaths in the BACK-TO-BACK HOUSES WITHOUT SIDE VENTILATION in these areas.

TABLE XI.—Deaths of residents, in the area in *Leeds*, in Through and Back-to-Back Houses, from all Causes and from certain specified Groups of Causes, during the decennium 1898-1907, classified in 11 Age Groups.

	0-5.	5-10.	10-15.	15-20.	20-25.	25-30.	30-35.	35-40.	40-45.	45-50.	50-55.	55-60.	60-65.	65-70.	70-75.	75 and upwards.	All Ages.			
																	M.	F.	M.	F.
Small-pox ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Measles ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scarlet fever ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Whooping-cough ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Diphtheria ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Enteric fever ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Diarrhoea ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pneumonia ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pneumonia {	Bronch. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Not defined ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bronchitis and other diseases of Chest (except Phthisis). ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phthisis ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Other Tubercular diseases ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Malignant diseases ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Diseases of Heart ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Diseases of Blood-vessels ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Diseases of Nervous system ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Diseases of Digestive system ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Premature birth ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Congenital defects ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Atrophy, Debility, and "Marasmus," ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Convulsions ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Teething ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Old Age ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Violence ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Other Causes ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
All Causes ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

158 157

33

52

29

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226

214

TABLE XII.—Mean annual crude death-rates per 1,000 from all causes and from certain groups of causes,\* as well as the mean annual death-rates from all causes, corrected for variations of sex and age constitution, in the through houses and the back-to-back houses of (a) all the areas, and (b) the areas which contained back-to-back houses with side ventilation.

(a) All the areas collectively.

Causes of death.	Through houses.	Back-to-back houses.	
		(1) Including those with means of side ventilation.	(2) Excluding those with means of side ventilation (rows only).
Small-pox, measles, scarlet fever, whooping-cough, diphtheria, and enteric fever.	1.00	1.34	1.50
Diarrhoea...	.69	.96	.95
Pneumonia (all forms)...	1.09	1.62	1.58
Bronchitis and other diseases of the Chest (except phthisis).	1.52	2.02	2.24
Phthisis ...	1.27	1.27	1.41
Other tubercular diseases	.52	.59	.59
Malignant diseases	.75	.67	.74
Diseases of the Heart ...	1.19	1.05	1.05
"    "    Blood vessels ...	.89	.92	.93
"    "    Nervous system	.55	.66	.67
"    "    Digestive system	.62	.61	.61
Premature birth, congenital defects, convulsions, teething, atrophy, debility, and "marasmus."	1.28	2.37	2.63
Old age ...	.75	.68	.80
Violence ...	.22	.24	.25
Other Causes ...	1.55	1.40	1.30
Crude death-rate from All Causes ...	13.89	16.40	17.25
Factors for correcting variations of sex and age constitution.	1.1630	1.1340	1.1284
<b>Corrected death-rate ...</b>	<b>16.15</b>	<b>18.60</b>	<b>19.46</b>
Comparative mortality ...	1,000	1,152	1,205

\* The death-rates from different causes given in this table, being *crude* death-rates, are not accurately comparable (see pp. 19 to 25).

TABLE XII—*cont.*(b) *Areas which contained back-to-back houses with side ventilation.*

Causes of death.*	Through houses.	Back-to-back houses.	
		(1) With means of side ventilation (Blocks of four only).	(2) Without means of side ventilation (Rows only).
Small-pox, measles, scarlet fever, whooping-cough, diphtheria, and enteric fever.	.93	.83	.97
Diarrhoea...	.67	.98	1.06
Pneumonia (all forms)...	1.06	1.71	1.45
Bronchitis and other diseases of the Chest (except phthisis).	1.18	1.32	2.06
Phthisis ...	1.18	.83	1.36
Other tubercular diseases	.58	.59	.39
Malignant diseases	.90	.44	.65
Diseases of the Heart ...	1.38	1.03	.71
" " Blood vessels ...	.99	.88	.71
" " Nervous system ...	.61	.64	.68
" " Digestive system ...	.67	.64	.77
Premature birth, congenital defects, convulsions, teething, atrophy, debility, and "marasmus."	1.18	1.51	2.65
Old age ...	.67	.29	.55
Violence ...	.22	.19	.32
Other Causes ...	1.50	1.71	1.58
Crude death-rate from all causes ...	13.72	13.59	15.91
Factors for correcting variations of sex and age constitution.	1.1305	1.1542	1.1277
<b>Corrected death-rate ...</b>	<b>15.51</b>	<b>15.69</b>	<b>17.94</b>
Comparative mortality ...	1,000	1,012	1,157

\* See footnote to previous table.

TABLE XIII.—Factors for correcting differences in the age and sex constitution of the populations living in through and back-to-back houses in all the areas, in the areas containing back-to-back houses with side ventilation, and in the area in Leeds, in respect of mortality from all causes and from certain specified groups of causes, calculated on the basis of mortality in England and Wales during the decennium 1891-1900 being unity in each case.

Populations for which factors of correction have been calculated.	Factors of correction for mortality from			
	All Causes.	Phtisis.	*Infectious Diseases.	Pneumonia, bronchitis, and other pulmonary diseases
1. All areas.				
(a) Through houses ...	1.1630	.9025	1.3462	1.2124
(b) Back-to-back houses	1.1340	.9085	1.1111	1.1716
(c) Back-to-back houses excluding those having side ventilation.	1.1284	.9145	1.0667	1.1630
2. Areas only which contained back-to-back houses with side ventilation.				
(a) Through houses ...	1.1305	.9025	1.3861	1.1716
(b) Back-to-back houses with side ventilation.	1.1542	.8910	1.2069	1.2077
(c) Back-to-back houses without side ventilation.	1.1277	.9025	1.1667	1.1660
(d) All back - to - back houses.	1.1383	.8968	1.1864	1.1805
3. Area in Leeds.				
(a) Through houses ...	1.2553	.9205	1.1475	1.3249
(b) Back-to-back houses	1.1455	.9392	.9211	1.1760

\* The group of infectious diseases comprises small pox, measles, scarlet fever, diphtheria, whooping-cough and enteric fever.

TABLE XIV.—Factors for correcting differences in the age and sex constitution of the populations in through and back-to-back houses, in respect of mortality *from all causes*, in the larger individual areas selected, mortality in England and Wales (1891-1900) being unity in each case.

Areas selected in	Factors of correction for mortality from all causes for populations living in			
	Through houses.	Back-to-back houses.	Back-to-back houses, excluding those with side ventilation (Rows only).	Back-to-back houses, excluding those without side ventilation (Blocks of four only).
Leeds ...	...	1.2553	1.1455	—*
Morley...	...	1.2224	1.1616	1.1668
Batley ...	...	1.1112	1.0931	1.1683
Bradford ...	...	1.0905	1.2224	—†
Huddersfield ...	...	1.0700	1.0613	1.0236
Halifax ...	...	1.1091	1.1586	—†
Keighley ...	...	1.1051	1.1160	1.1160
Other towns ...	...	1.1502	1.0720	—*

\* No population.

† Population too small for correction.

TABLE XV.—Showing the relative death-rates from all causes and from certain special causes in through and back-to-back houses, the death-rate in through houses in each instance being given as 100. (In the columns marked (—) no records were available.)

		Population concerned.	All Causes.	Chest Diseases omitting Consumption.	Consumption.	Diarrhoea.	Infant Mortality.
Salford, 1879-83 (Dr. Barry and Dr. Gordon Smith, data supplied by Mr. Tatham.)	.1. Through houses <i>Two districts:</i> (a) Consisting of houses of which 21 per cent. were back-to-back. (b) Consisting of houses of which 56 per cent. were back-to-back.	8.713	100	100	100	100	—
	<i>B. Through houses</i> <i>Two districts:</i> (a) Consisting of houses of which 18 per cent. were back-to-back. (b) Consisting of houses of which 50 per cent. were back-to-back.	11.749	106	118	118	109	—
		11.406	111	120	129	149	—
	<i>B. Through houses</i>	54.264	100	100	100	100	—
Shipley 1887-1892 (Dr. Herbert Jones.)	.1. Through houses B. Back-to-back houses B. Back-to-back houses A. Six wards having under 60 per cent. back-to-back houses B. Nine wards having over 60 per cent. back-to-back houses	8.773	112	132	100	120	—
Bradford, 1890-1892 (Dr. Arnold Evans.)	.1. Through houses B. Selected districts, back-to-back houses A. Through houses B. Back-to-back houses	4.380	113	151	167	184	—
Manchester, 1891-1891. (Dr. Niven.)	.1. Through houses B. Back-to-back houses A. Through houses B. Back-to-back houses	4.218	100	100	100	100	—
Whickham, U.D., Durham, 1896 (1905). (Dr. Darra Mair.)	.1. Through houses B. Back-to-back houses A. Through houses B. Back-to-back houses	4.155	135	142	126	182	—
13 towns investigated for Local Government Board, 1898-1907. (Dr. Darra Mair.)	.1. Through houses B. Back-to-back houses without side ventilation (a) Through houses (b) Back-to-back houses without side ventilation	202.976	100	—	—	—	—
			120	—	—	113	—
			76.233	100	100	100	231
			9.726	122	118	111	100
			1.158	109	—	—	163
			718	127	—	—	100
			3.797	115†	185	100	165†
			6.781	100	100	100	—
			3.797	115†	185	100	—
			1.965	100	100	100	—
			2.150	117	123	115	67†

\* Comparable areas were selected in the following towns:—Leeds, Morley, Batley, Bradford, Huddersfield, Halifax, Keighley, Cleckheaton, Brighouse, Dewsbury, Linthwaite, Heckmondwike, Pudsey. The death-rates are corrected for sex and age distribution.

† If the 2,000 persons living in the back-to-back houses which had side ventilation be excluded from this series, the excess mortality as compared with through houses is 21 per cent. instead of 15 per cent.

‡ Based on death-rates per 1,000 living under 5 years of age.

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BY  
DR. L. W. DARRA MAIR,  
WITH AN  
INTRODUCTION  
BY THE  
MEDICAL OFFICER OF THE BOARD.

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A report on Relative Mortality in Through  
and Back-to-Back Houses in certain Towns  
in the West Riding of Yorkshire.

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Presented to both Houses of Parliament by Command of His Majesty.

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